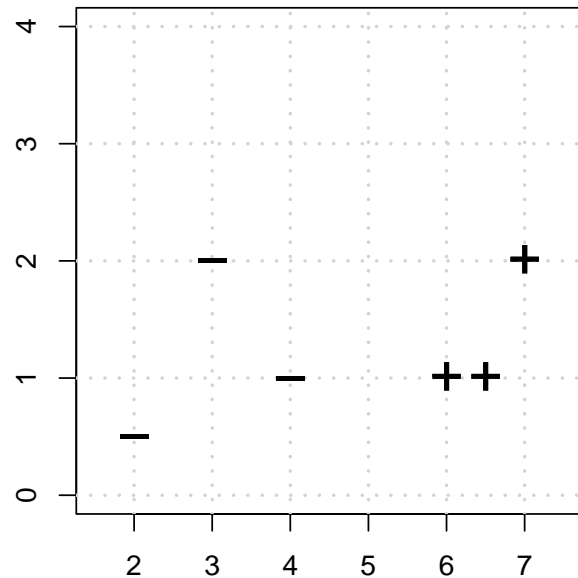


### Exercise 1: Hard Margin Classifier

The primal optimization problem for the two-class hard margin SVM classification is given by

$$\begin{aligned} \min_{\theta, \theta_0} \quad & \frac{1}{2} \|\theta\|^2 \\ \text{s.t. :} \quad & y^{(i)} \left( \langle \theta, \mathbf{x}^{(i)} \rangle + \theta_0 \right) \geq 1 \end{aligned}$$



(a) Calculate the following quantities:

- $\gamma$
- $\|\theta\|$
- $\theta$
- $\theta_0$
- Determine which points are support vectors.

(b) What may change in (a) if the following things happen:

- All points are rotated by 45 degrees counterclockwise.
- All points are shifted by 2 to the right (in the x-axis).
- One SV moves closer to the separating hyperplane.
- One SV is removed from the dataset.